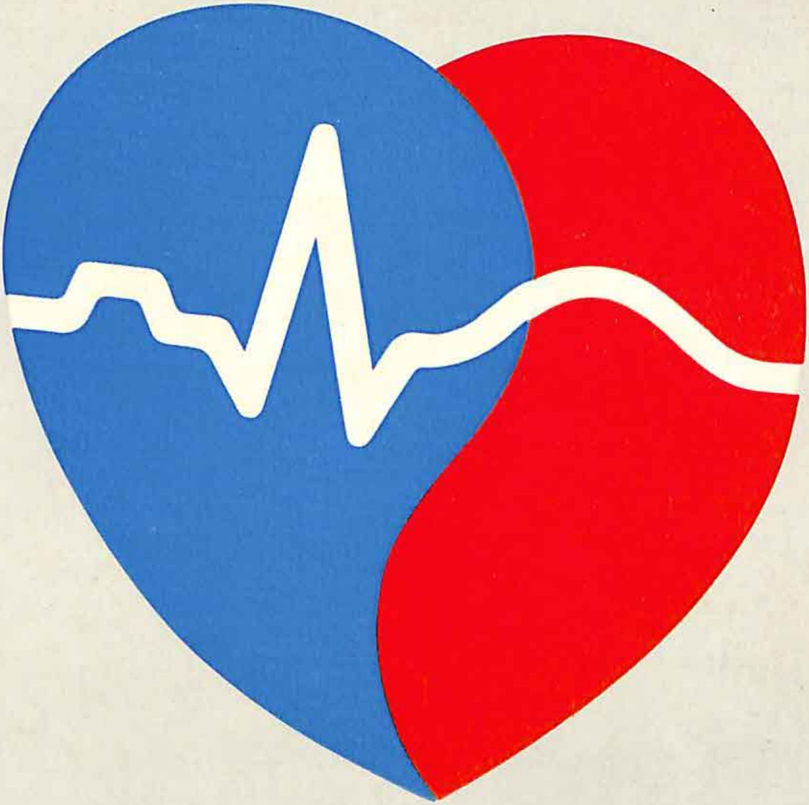
HEART DISEASE

and the layman

DR. S. PADMAVATI



HEART DISEASE
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Popular Science

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S. PADMAVATI

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CHAPTER—I

THE NORMAL HEART: STRUCTURE & FUNCTION

WHAT IS THE NORMAL HEART AND WHAT DOES IT DO?

The heart is a strong muscular pump whose function is to pump blood to reach every part of the body from head to foot.

LOCATION, WEIGHT AND STRUCTURE

It is located slightly to the left of the centre of the chest between the chest bones and the spine. The weight of the heart of an adult is 200-350 grams. (Men—250-350 grams. Women—200-300 grams).

Externally the heart has the shape of an egg with the smaller end pointing downwards where you can feel it beating (Fig. 1).

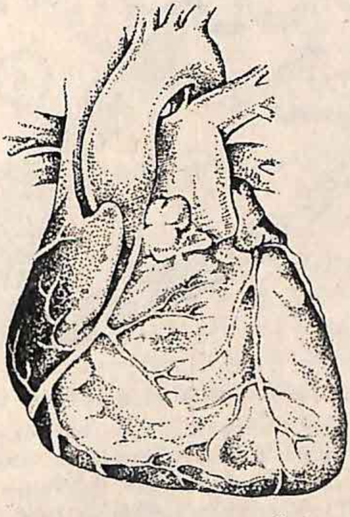


Fig. 1. External appearance of the heart

Internally it consists of four chambers, two above and two below. The upper chamber is the atrium and the lower—the ventricle. A muscular wall called the septum divides the heart into right and left chambers and each side has a different function (Fig. 2).

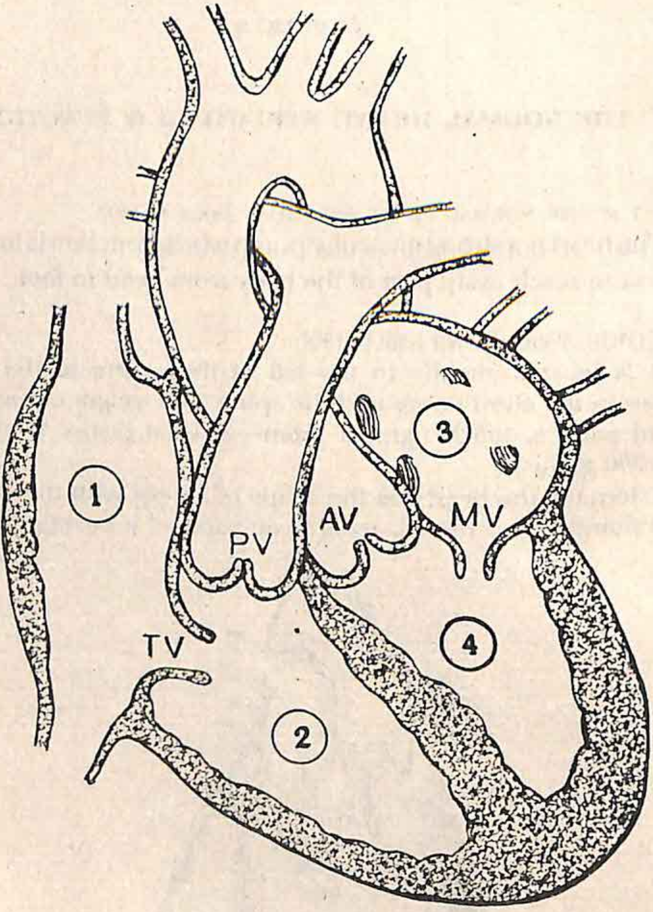


Fig. 2. Heart chambers and heart valves

1. Right atrium
2. Right ventricle
3. Left atrium
4. Left ventricle

MV—Mitral valve
AV—Aortic valve
PV—Pulmonary valve
TV—Tricuspid valve

The tough heart muscle called myocardium is covered by a fluid bag called pericardium which protects it from rubbing against the lungs and the wall of the chest. It has a thin inner lining which is in contact with blood and is called endocardium.

There are valves between the chambers which open and close to regulate the flow of blood only in one direction.

CORONARY ARTERIES

Two main channels and their branches cover the heart muscle like a crown and are called coronary arteries. These arteries supply the myocardium with nutrients and oxygen for performing its pumping job and hence are very important (Fig. 3).

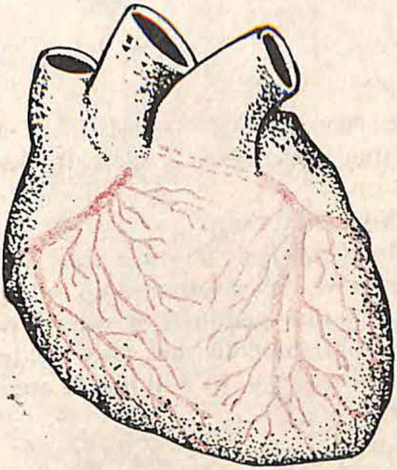
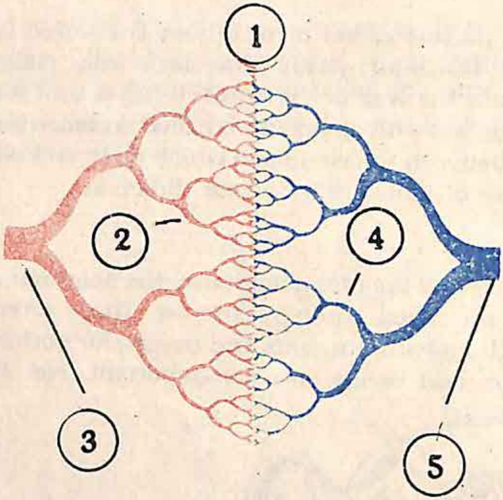


Fig. 3. The heart showing coronary arteries and their branches

BLOOD VESSELS, ARTERIES, VEINS AND CAPILLARIES

Blood flows out of the heart by a system of pipes or tubes called arteries which branch out into smaller and yet smaller vessels ending finally in hair-like tubes (which cannot be seen by the naked eye) called capillaries. The arteries are strong and elastic and the biggest of these has a diameter of about 3 cms. which comes out of the left ventricle and is called the aorta.

Veins, small and big, bring blue or impure blood back to the heart for purification. If all the channels of blood circulation are



1. Capillaries
2. Arterioles
3. Artery
4. Venules
5. Vein

Fig. 4. Circulation showing final divisions of blood vessels

put end to end, they can cover or go along the equator four times (Fig. 4).

THE BLOOD: CONSTITUENTS (PARTS)

Blood consists of red cells (erythrocytes), white cells (leucocytes) and water in which are either dissolved or are in a state of suspension, oxygen, tiny quantities of sodium, potassium, sugar, urea, iron and other minerals and fatty matter, platelets and fibrous matter (fibrinogens). In addition it consists of vitamins and enzymes, etc.

ACTION OF THE HEART

The right upper chamber (right atrium) receives venous or blue impure blood. It then flows down to the right lower chamber (right ventricle) which pumps it to the lungs where it is purified by addition of oxygen. From the lungs, purified blood, which is red, comes to the left atrium and then flows to the left ventricle which pumps it out through the aorta.

The right and left ventricles contract simultaneously to pump blood respectively to the lungs and to all parts of the body. The vast network of arteries and veins constitute the circulatory system (Fig. 5).

The Cycle

1. Oxygen-poor blood from the body collects in the right atrium which contracts filling up the right ventricle

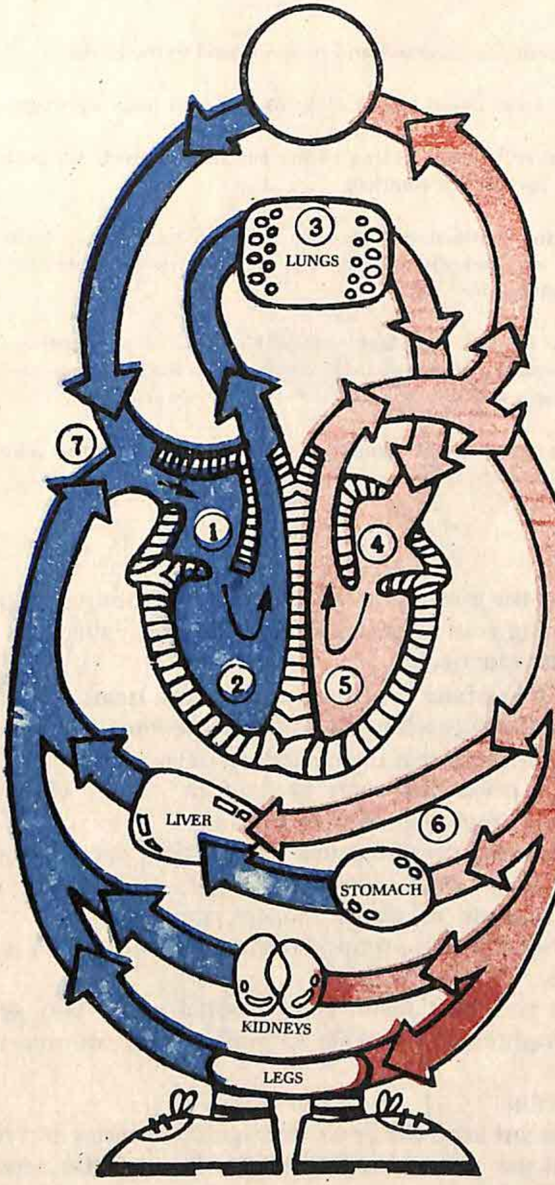


Fig. 5 The cardiac cycle
(red)—Oxygen-rich blood
(blue)—Oxygen-poor blood

2. Right ventricle contracts and pushes blood to the lungs
3. In the lungs blood loses carbon dioxide and picks up oxygen
4. Oxygen-rich blood returns to the left atrium which contracts filling up the left ventricle
5. Powerful contraction of the left ventricle expels oxygen-rich blood into the aorta from which artery branches distribute blood throughout the body
6. In the muscles and body organs blood releases oxygen and nutrients and absorbs food and water from the intestines. Liver processes nutrients and together with kidneys purifies the blood
7. Oxygen-poor blood returns to the heart through the veins. Another cycle begins.

THE PULSE

You can feel the movement of blood through the arteries of your body by placing your fingers over the artery at your wrist or on either side of your neck.

There are two phases in the action of the heart. The first is contraction or systole when blood is pumped out. The second is a very brief period of rest or relaxation—diastole.

There is a pulse for each beat of the heart which is a combination of one systole and diastole.

For an adult, the normal pulse rate is 60-90 per minute or in other words about 85,000 beats per day. In children the rate is 100-120 per minute or about 140,000 per day.

The quantity of blood pumped during each heart beat is about 70 millilitres.

The heart will beat faster than normal when you get very excited or frightened or while exercising very strenuously.

THE CIRCULATION

Blood goes out from the heart through the arteries and returns to it through the veins. Blood circulates through the network of arteries and veins.

The quantity of blood normally present in the body is 6-7 litres. It takes 60-90 seconds for the outgoing blood to return to the heart (Fig. 6).

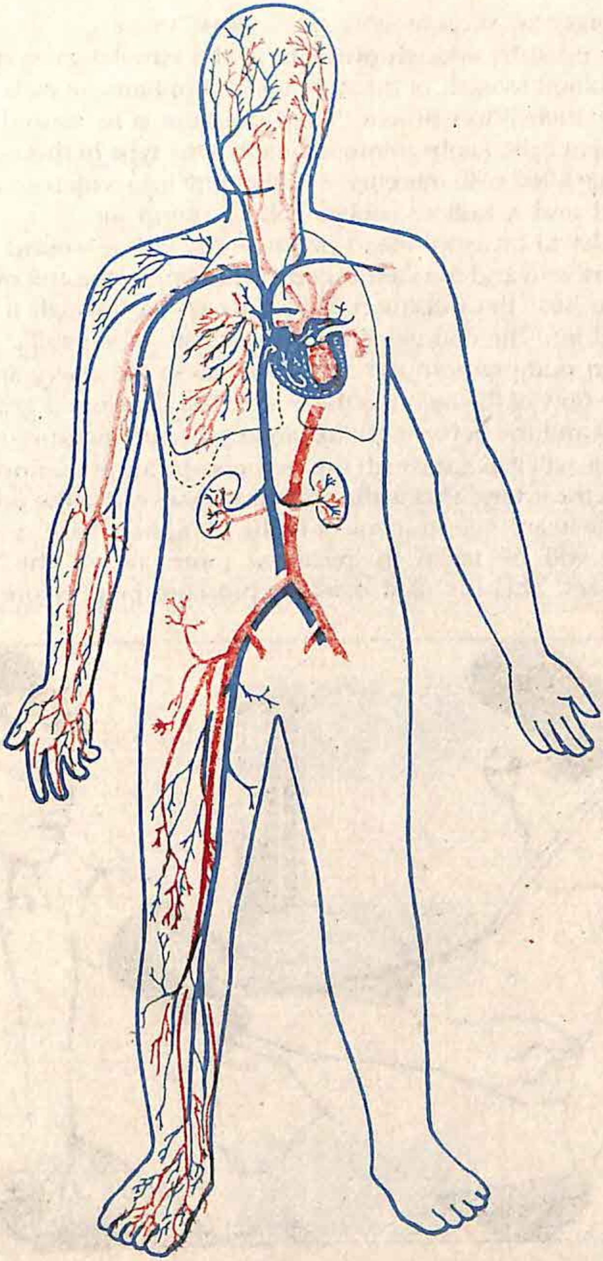


Fig. 6. The heart and circulatory system

BLOOD PRESSURE: MEASUREMENT AND NORMAL VALUE

There must be enough pressure in the circulatory system to supply blood to each of the millions and millions of cells in the body for their nourishment. Blood pressure is measured by an instrument called sphygmomanometer. One type of this consists of a gauge filled with mercury, a rubber cuff into which air can be pumped and a hollow rubber ball to pump air.

In order to measure blood pressure the cuff is wound round the upper arm and the stethoscope is put below the cuff over the artery to hear the pulsation of blood passing through it. Air is pumped into the cuff using the rubber ball. When sufficient air has been pumped into the cuff it will press the artery and will stop the flow of the blood in the artery. The pressure is gradually released and the persons taking blood pressure measurement in the gauge will listen through the stethoscope for the sound of the pulse in the artery. This is the systolic pressure. It is the pressure when the heart is contracting or in the pumping phase. A second reading will be taken by releasing more air till the sound disappears. This is called diastolic pressure or pressure when

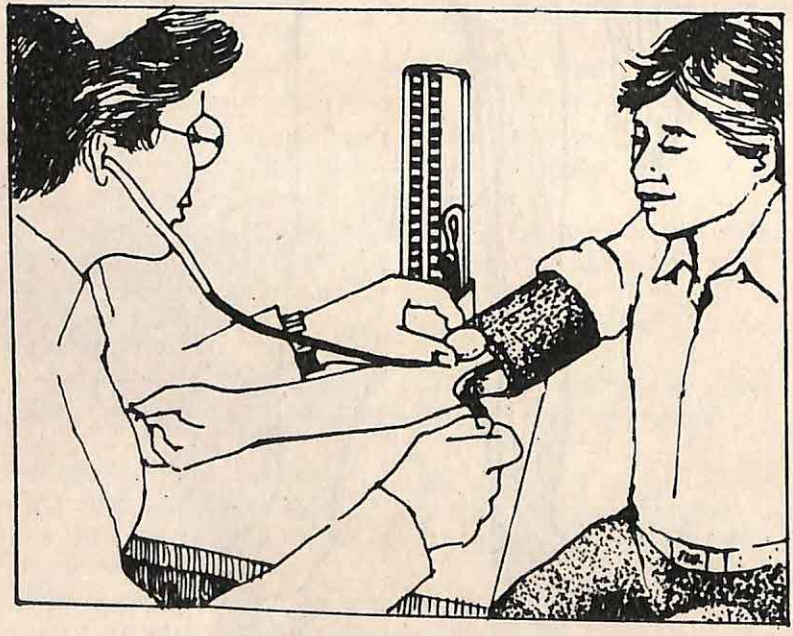


Fig. 7. Measurement of blood pressure

the heart is relaxing. The recording is written 130/80 mm Hg (Hg stands for mercury), the upper figure denoting systolic pressure and the lower, diastolic pressure.

Normal blood pressure in adults is not more than 140 systolic and 90 diastolic. Blood pressure will change during a normal day falling to its lowest during sleep and rising when exercising vigorously for instance, or when excited (Fig. 7).

CHANGES IN THE HEART AND BLOOD VESSELS WITH AGE

With advancing age changes take place in the arteries as well as the heart. Till recently these changes were considered to be the effect of degeneracy of various body functions due to aging. It is now believed that this is not so but is due to deposition of fatty matter and fibrous substances in the arteries. It is considered that this is a process which begins in childhood. This process is commonly called rusting in the same way as a water-pipe rusts by deposition of matter in its inner wall and thereby causing obstruction to free flow. Medically the process is called atherosclerosis (sometimes arteriosclerosis) which results in the arteries

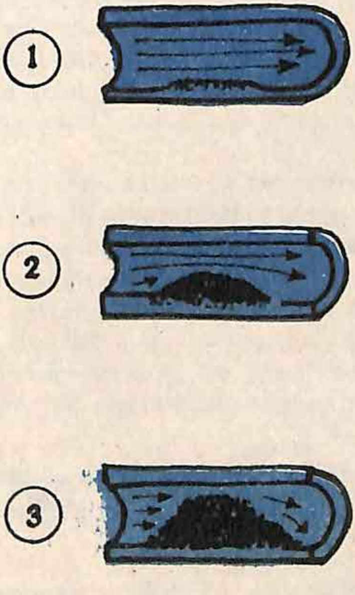


Fig. 8. Development of atherosclerosis

losing their elasticity or getting hardened instead of being flexible and their inner diameter will become narrow (Fig. 8). When this happens the heart will have to exert itself more than normal to pump blood to reach the extremities of the body. This may put a strain on the heart. When the coronary arteries are atheromatous, blood supply to the heart may not be enough to meet the demand for the work performed by it. Sometimes a blood clot may completely block the flow of blood with severe consequences, i.e. heart attack.

CHAPTER—II

METHODS OF EXAMINATION OF THE HEART

This consists of two parts: the physical examination and laboratory tests. The physical examination is most important as it will enable the physician to give an indication as to what the patient is suffering from and to indicate what laboratory tests are required. The more mature the clinician the more expert will be his physical examination.

PHYSICAL EXAMINATION

This consists of the general examination of the patient and examination of the cardiovascular system with a recording of the blood pressure and the use of the stethoscope. The blood pressure will have to be recorded, especially if the patient is on medication, in the lying, sitting and standing positions.

LABORATORY TESTS FOR EXAMINATION OF THE CARDIOVASCULAR SYSTEM

The doctor will decide as to which of the more elaborate tests are really necessary considering the expense and labour involved. Simple tests, such as the ECG, X-Ray, urine and blood tests are required for every patient. Certain other tests in the non-invasive and invasive categories will be decided on by the cardiologist concerned as they are more expensive than the routine tests. A brief description of these tests is given below:-

1. **Chest X-Ray:** This is usually done in the PA position but other views may be required (Fig. 9).

2. **Electrocardiogram:** A twelve lead electrocardiogram is usually taken with special extra lead, if required (Fig. 10).

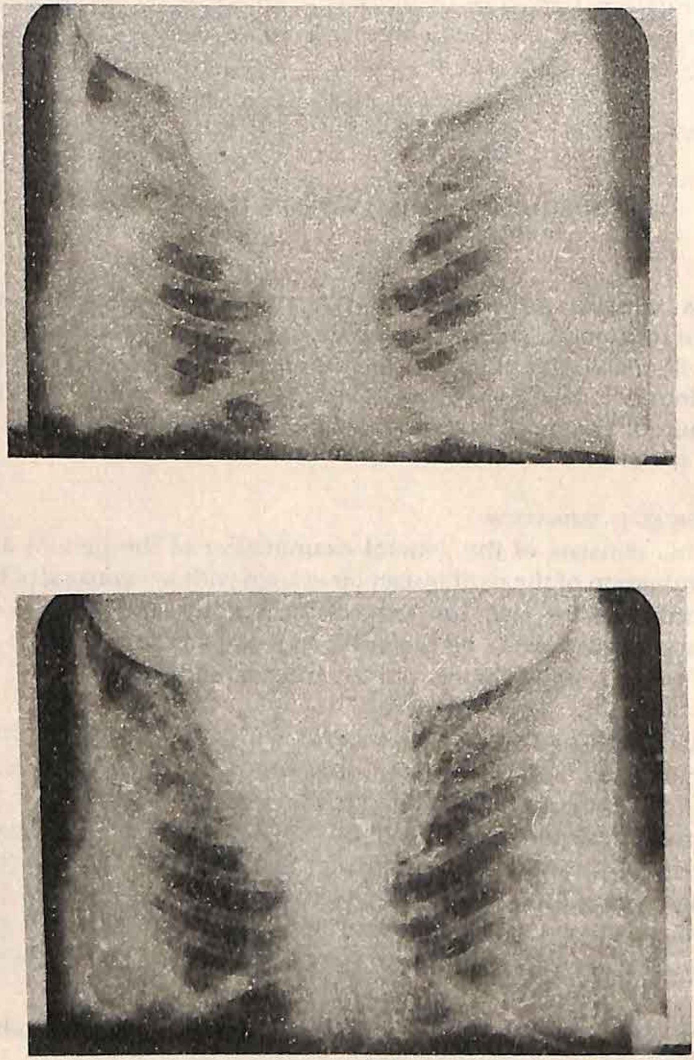


Fig. 9. Normal chest X-Ray

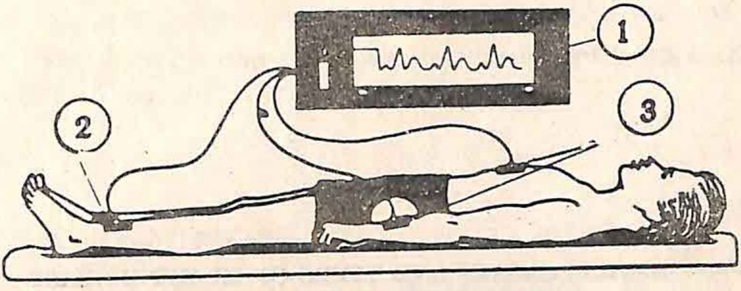


Fig. 10. Electrocardiogram (ECG)

3. **Routine blood tests** include those for blood sugar, fasting and postprandial, serum cholesterol, triglycerides, lipid profile, blood urea and urea nitrogen, serum creatinine, serum uric acid, serum enzymes and serum electrolytes as and when required. Certain other tests may be necessary for special cases. A haemotogical work-up is also required as well as the test of the urine in a routine examination.

SPECIAL CARDIOVASCULAR TESTS

These fall under two categories:

1. Non-invasive tests such as a treadmill, 2 D echocardiography (with doppler), ambulatory monitoring and radio isotope studies.
2. Invasive tests are cardiac catheterisation and angiocardiography. These require puncture of a blood vessel and introduction of a catheter inside the heart for study of pressures, etc.

The details of these will not be gone into here. Normal values for biochemical tests are given elsewhere in the book (Appx. II).

CHAPTER—III

PREVALENCE, CAUSES AND TYPES OF HEART DISEASE

PREVALENCE OF HEART DISEASE

Diseases of the heart and blood vessels account for about 53% of all causes of death below the age of 65 in western countries. Cancer accounts for about 20%; accidents for about 4% and the balance is made up of other causes, such as infections, etc. In developing countries, such as India, the exact prevalence is not known because of poor statistics as also a large number of cases of infectious disease. However, it is believed that with improvement in sanitation and nutrition and with increase in the life span to between 50 and 60 years, coronary heart disease will become the most important cause of death in developing countries also. This trend is already apparent in India.

CAUSES OF HEART DISEASE

Heart disease can occur from congenital malformations present at birth, from infections of the heart (of heart valves, myocardium and pericardium) as happens in rheumatic heart disease and infective endocarditis, from diseases of the blood vessels supplying the heart, with resultant lack of supply to the heart muscle (coronary or degenerative heart disease) or secondary to high blood pressure (hypertensive heart disease) and also secondary to any disease of the lungs (pulmonary heart disease). The most common causes in India in order of prevalance are:-

—Rheumatic heart disease (RHD) affecting MOSTLY CHILDREN AND YOUNG PEOPLE and accounting for a large number of patients below the age of 30.

—Coronary heart disease, the most dreaded of all and accounting for an increasing number of cases at the present time.

—Hypertensive heart disease due to high blood pressure.

—Congenital heart disease from birth defects and prevalent in about 3 children per 1000 between 5 and 15 years of age.

These are the only types of heart disease which will be dealt with in ensuing pages.

TYPES OF HEART DISEASE

Coronary Heart Disease

Coronary heart disease, also called atherosclerotic heart disease, is caused by clogging and narrowing of the coronary arteries whose functions have been described earlier. A heart attack occurs if an artery becomes blocked and prevents blood from nourishing the heart muscle. The same atherosclerosis may occur in arteries elsewhere in the body and may affect the brain producing a stroke of paralytic attack, the kidneys with renal failure and the blood vessels of the leg leading to gangrene.

RISK FACTORS

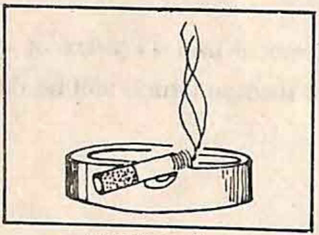
In recent years, certain predisposing factors (also called risk factors) have been identified and they have been intensively studied. These are:

- Tobacco smoking
- high blood pressure
- raised blood fat levels
- diabetes
- lack of physical activity
- obesity

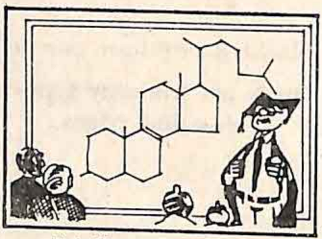
As these are easily identifiable factors, these will be dealt with in some detail (Fig. 11).

SMOKING

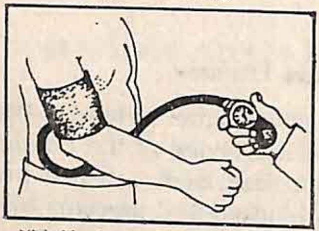
Both cigarette and beedi smoking are very important risk factors. Beedies contain more tobacco than cigarettes and are therefore more harmful. Pipe and cigar smoking are less harmful as the smoke is not inhaled. The risk of sudden death from heart attacks in smokers is 5 times higher than in non-smokers. Fortunately, the risk for ex-smokers decreases to almost the same level as for people who have never smoked.



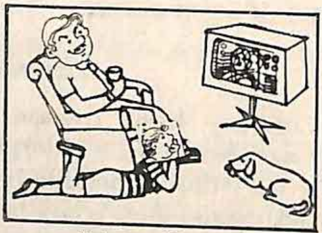
Cigarette smoking



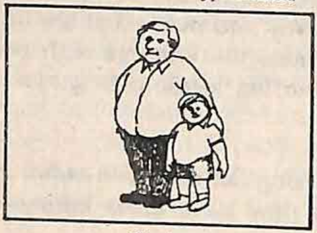
High blood cholestrol levels



High blood pressure (Hypertension)

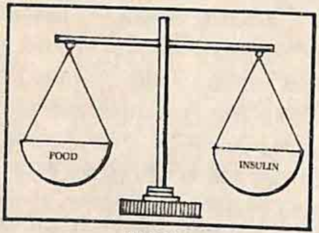


Sedentary life style

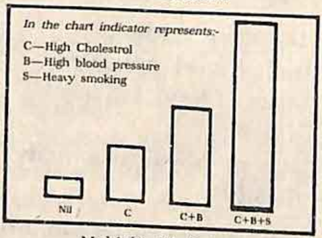


Obesity

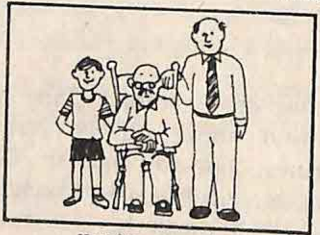
Other risk factors



Diabetes



Multiple risk factors



Heredity, age and sex

Fig. 11. Risk factors in ischeamic heart disease

HIGH BLOOD PRESSURE

High blood pressure produces 4 times greater risk of heart attack. As this condition may be completely asymptomatic, it is called a silent killer. The only way to find out whether one has high blood pressure is by having the pressure measured.

HIGH CHOLESTEROL LEVEL

Cholesterol is essential to life but excess cholesterol and fats in the blood contribute to clogging of the arteries which result in heart attacks. The higher the level of cholesterol in the blood, the higher the risk of heart attack. Diet influences serum cholesterol levels to a large extent.

DIABETES

Heart disease is several times more common in diabetics and occurs at an earlier age than in non-diabetics. Mostly diabetes occurring late in life is triggered by obesity, heredity, age and sex. A family history of heart attacks or high blood pressure increases the risk.

AGE & SEX

The chance of heart disease increases with age in both sexes and in women after the change of life. Women taking the "pill", especially those who also smoke, are at greater risk.

OBESITY

People who are more than 20% over-weight have 3 times the risk of those slightly under-weight. People who are over-weight tend to have higher blood pressures, higher cholesterol levels and diabetes.

SEDENTARY LIFE STYLE

People who are physically inactive run a 2 or 3 times greater risk of heart attack than very active persons. It is now believed that regular exercise strengthens the heart and improves the circulation. It also helps to control high cholesterol, body-weight, stress and blood pressure.

STRESS AND BEHAVIOUR PATTERNS

"Type A Behaviour" may be an important factor in heart attack. Many of those prone to heart attacks are over-ambitious and easily excited. Prolonged anxiety and depression may also increase the risk of heart disease as well as other ailments.

OTHER RISK FACTORS

There are probably some other risk factors which play a role in predisposing individuals to heart attack such as soft water, trace elements, etc. which are not clearly identified.

MULTIPLE RISK FACTORS

Combined risk factors do not simply add, they multiply the risk. A person with three major risk factors is about 10 times more likely to suffer a heart attack than his normal counterpart. Two personal risk charts are given in Tables 1 & 2 from which you can know your risk point for a heart attack. You may enjoy calculating your own risk from the charts.

SYMPTOMS OF HEART ATTACK

Atherosclerosis of the coronary arteries may develop slowly to a point where complications occur without warning.

1. Sudden death may occur and advanced diseases of the coronary arteries is the commonest cause of sudden death with or without warning symptoms.
2. Angina or chest pain is the commonest symptom. The chest pain is usually felt in the middle of the chest and may radiate to the neck or jaws or down either arm to the elbows or wrist. This is essentially a cry of the heart for blood. It usually occurs during physical exertion, after emotional upset or after a heavy meal. Relief comes with rest or by a tablet under the tongue. An anginal attack is not a heart attack. The heart muscle recovers from the temporary oxygen shortage before damage to it occurs. People who feel angina pain should consult a doctor. Sometimes angina may occur at rest or during sleep. This is a more serious condition.
3. *Heart Attack (Coronary Attack, Myocardial Infarction)*
   Chest pain or discomfort similar to angina but lasting more than 15 minutes may mean a heart attack. This means that a portion of the heart muscle actually dies due to sudden prolonged oxygen shortage. A heart attack may occur due to insufficient blood flow through a narrowed coronary artery or

Table 1

Risk Points for Coronary Heart Disease

RISK FACTORS	*0*	*1*	*2*	*YOUR SCORE*
CIGARETTE SMOKING	Non-smoker	15 or less daily	Over 15 daily	
BLOOD PRESSURE	Low or normal	Raised or Don't know	High	
CHOLESTEROL & FAT LEVELS IN BLOOD	Below average	Average or Don't know	Above average	
WEIGHT	Normal	Overweight	Obese	
DIABETES	No diabetes	Family history of diabetes	Diabetic	
EXERCISE	Vigorous on most days	Vigorous once or twice each week	Usually inactive	
BEHAVIOUR TYPE AND STRESS	Easy-going contented	Often hurried, anxious, intolerant	Hurried competitive aggressive	
FAMILY HISTORY	No premature heart disease	Heart disease before age 55	—	
AGE	Under 40	40-50	Over 50	

Total Points—

How did you score

0 – 2 points .... Low risk
3 – 5 points .... Moderate risk
6 – 9 points .... Excessive risk
10 – or more .... High risk

Reduce score where possible

Notes on Risk Assessment

1. To be at risk of Coronary Heart Disease (CHD) is not the same as having CHD. Risk assessment cannot determine whether someone will or will not develop CHD, but it does indicate whether CHD is likely or not. See a doctor for a full risk assessment with blood tests.
2. Risk assessment tends to overlook people with numerous borderline abnormalities. Such people may be at a higher risk of CHD than is indicated by this simple risk chart.

Table 2

Probability of Developing Coronary Heart Disease in 6 Years: Men (Aged 35-70)

Points	0	1	2	3	4	5	6	7	8	9	10
SBP	100	110	120	130	140	150	160	170	180	190	200
CIG	No				Yes						
LVH	No						Yes				
GLU	No		Yes								

	Age											
Chol	36	38	40	42	44	46	48	50	55	60	65	70
165	3	6	9	11	14	16	18	19	23	26	27	27
180	5	8	10	13	15	17	19	20	24	26	27	27
195	7	9	12	14	16	18	20	21	24	26	27	27
210	8	11	13	15	17	19	21	22	25	27	27	27
225	10	12	15	17	19	20	22	23	26	27	28	27
240	11	14	16	18	20	21	23	24	27	28	28	27
255	13	15	17	19	21	23	24	25	27	28	28	27
270	15	17	19	21	22	24	25	26	28	29	28	26
285	16	18	20	22	24	25	26	27	29	29	28	26
300	18	20	22	23	25	26	27	28	29	29	28	26
315	20	22	23	25	26	27	28	29	30	30	29	26

Compiled by Erica Britain at
Stanford University, 1979, from multiple
logistic functions in *The Framingham Study,*
Sec. 27, 1971, U.S. Government Printing Office.

Calculation of Probability

Enter Points for

____________ Systolic Blood Pressure
+ ____________ Cigarette Smoking
+ ____________ Left Ventricular Hypertrophy
+ ____________ Glucose Intolerance
+ ____________ Age/Serum Cholesterol
= ____________ Total Points→Probability

TP	Prob	TP	Prob	TP	Prob
5	.003	20	.021	35	.13
6	.004	21	.024	36	.14
7	.004	22	.028	37	.16
8	.005	23	.031	38	.17
9	.006	24	.035	39	.19
10	.006	25	.040	40	.21
11	.007	26	.045	41	.23
12	.008	27	.050	42	.25
13	.009	28	.057	43	.28
14	.010	29	.064	44	.30
15	.012	30	.071	45	.33
16	.013	31	.080	46	.36
17	.015	32	.090	47	.39
18	.017	33	.100	48	.42
19	.019	34	.11	49	.45

15295

due to the formation of a blood clot on the diseased lining of the coronary artery (Fig. 12). Thrombosis occurs if a blood vessel is already blocked by atheroma. It is most likely to occur in the presence of atherosclerosis but may also occur whenever blood flow is sluggish. Factors increasing the chance of thrombosis are rhythm disturbances, a sluggish blood flow, tobacco smoking, stress and contraceptive pills when taken by women who smoke. Factors decreasing the chance are low serum cholesterol levels, aspirin, dietary factors, such as, poly-unsaturated fats and regular exercise.

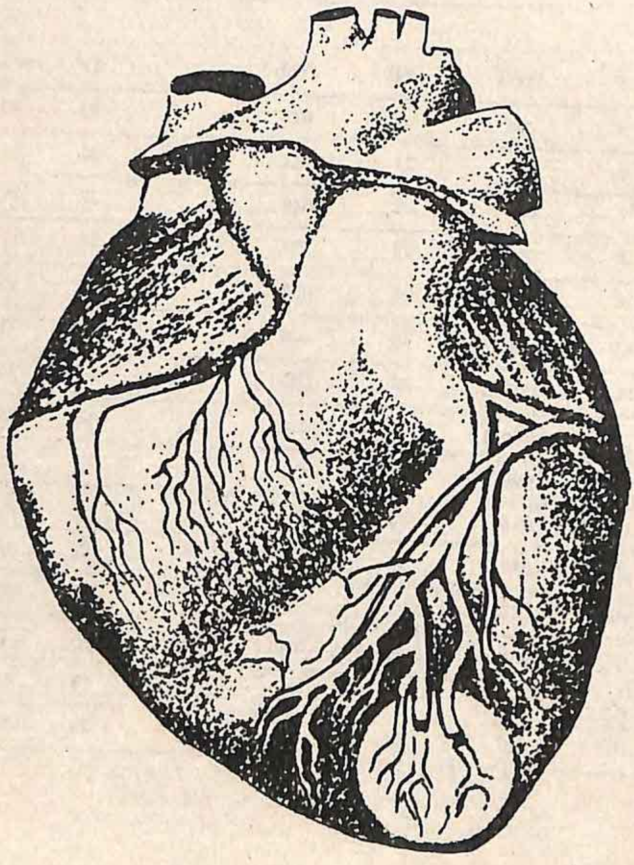


Fig. 12. Blockage of coronary artery

4. *Heart Beat Disturbances*

Whenever the heart muscle is impaired by an oxygen shortage, its electrical system may be upset. Extra heart beats and non-rhythmic muscle contractions interfere with pumping efficiency of the heart. These arrhythmias can be serious.

TREATMENT

Anybody experiencing symptoms of angina or any rhythm disturbance should consult a physician for a thorough check-up. Self-medication is not advised. Immediate treatment is rest and requisitioning the services of a physician as soon as possible. The treatment of a heart attack is best done in a hospital and will not be gone into here. The treatment of angina should also be under the guidance of a physician and involves the following:-

MEDICAL TREATMENT

Control of risk factors have already been mentioned, i.e. smoking, over-weight, control of diabetes, of high serum cholesterol levels, of high blood pressure and stress. The three important groups of drugs for the treatment of angina are: Nitrates for immediate and continued relief, B-blockers and Calcium-blockers. Every patient must be given adequate treatment along these lines and if the symptoms are not controlled the question of angiography and bypass surgery should be considered. Coronary bypass surgery is not a cure but only a palliative procedure. The same precautions with regard to risk factors will have to continue even after bypass surgery.

CORONARY ANGIOGRAPHY

Coronary angiography has already been described in the introductory chapter on "methods of examination". It is an essential procedure before surgery is considered as it determines the site of the block in one or more coronary arteries and also the state of the heart muscle.

CORONARY ANGIOPLASTY

This is an alternative procedure to surgery which is being increasingly adopted in suitable cases. Provided the block is accessible and not in more than 2, 3 or even 4 vessels, the narrowing can be dilated by the use of a suitable inflatable balloon with increasing pressures. It is being increasingly used throughout the world and represents an improvement in the treatment of narrowed arteries, provided they are not too extensive.

CORONARY BYPASS SURGERY

This is illustrated in the accompanying diagram. Narrowed or blocked arteries are "bypassed" by the use of a segment of vein taken from the leg which is connected to the aorta at one end and to the distal segment below the block on the other. The internal mammary artery may also be used as one of the bypass grafts instead of a vein and tends to stay open longer. Grafts may remain open for long or close after a time. Much depends on the technique used, on the continuance of risk factors and other factors not well understood. In recent years, many patients have to have a second operation after a lapse of several years because of closure of these grafts. However, a majority of patients feel considerable relief from the disabling pain of angina and the quality of the life is improved (Fig. 13).

PREVENTION

The cost of a heart attack is extremely high because of the number of days lost in hospital, cost of hospital care, the emotional trauma to the patient and relatives and if surgery is needed, the high cost of this procedure. Prevention is the logical course to follow and many affluent countries now have vigorous preventive programmes. The earlier the age at which these preventive measures are started, the greater the long-term benefits. It is believed now that it should start in childhood and in schools to prevent heart attacks in later life. The guidelines for a preventive programme are given in Chapter IV.

Hypertension and Hypertensive Heart Disease

As blood pressure goes up, life expectancy comes down. Studies carried out in India do not show such a high prevalence of high blood pressure in this country as in some others. The highest prevalence rate is 10% and the lowest well below 1%. Rural areas have much less high blood pressure than urban.

CAUSES OF HIGH BLOOD PRESSURE

The body has a complex regulatory mechanism for controlling

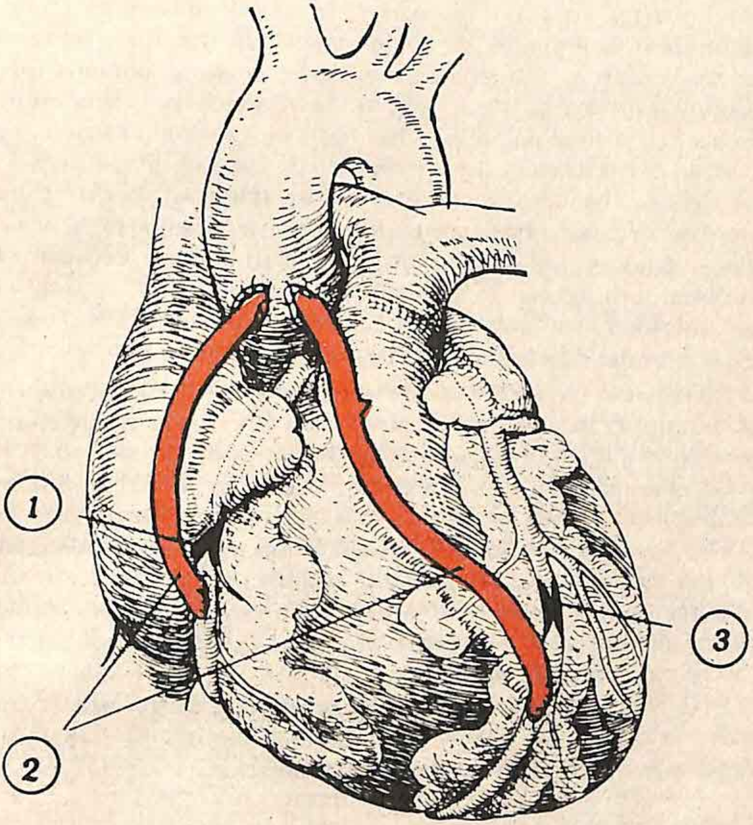


Fig. 13. Coronary bypass grafting

1. Blockage
2. Vein graft
3. Blockage or narrowing

Drawing of heart with two vein grafts sewn into place to bypass two narrowed arteries. Blood leaving the heart from the aorta will flow into the vein grafts and bring oxygen to the heart muscle beyond the blockages.

blood pressure allowing blood to be directed to parts of the body most in need. For example during exercise, such as cycling, the blood vessels in the legs widen to allow maximum blood penetration to leg muscles while muscles in the other parts of the body such as the stomach constrict. In some persons this regulating mechanism goes wrong. Blood pressure builds up in the arterial system and affects the heart by causing it to increase in size and thickness (hypertrophy), by causing blood vessels throughout the body to thicken (atherosclerosis). It may thus produce coronary heart disease leading to angina or a heart attack, fatal or non-fatal congestive heart failure. Because of working hard against high blood pressure the heart muscle at first thickens and later dilates causing congestion in the veins leading to the heart with resultant shortness of breath, swelling of the legs, etc. Stroke or sudden paralysis is due to interruption of blood supply to a part of the brain from atherosclerosis of blood vessels by a haemorrhage or thrombosis. Other arteries such as those of the kidney, eyes or legs may be affected leading to kidney failure, loss of sight, or pain or loss of function in the legs.

The cause of 90% to 95% of high blood pressure is unknown but may be influenced by heredity and life style. 5 to 10% are due to curable medical conditions such as kidney disease, congenital heart disease and endocrine disorders such as those of the thyroid or adrenal glands.

Hypertension may occur during pregnancy, in the elderly and may be caused by drugs such as anti-depressants, appetite-reducers, contraceptive tablets and steroids.

SYMPTOMS

There may be no symptoms for high blood pressure. However, many patients who know they have high blood pressure develop a number of symptoms such as headache, weakness, etc. which may not be related to the level of high blood pressure. Severe headache, particularly on walking in the morning, loss of vision, signs of cardiac involvement (angina), congestive failure and kidney or other disorders are caused late in the disease.

PREVENTION AND TREATMENT

Prevention of high blood pressure without drugs is now-a-days advocated especially in persons who have a family history of high blood pressure. These measures are:

- maintaining ideal body weight
- eating less salt by reducing the amount of salt consumed in foods
- avoidance of alcohol in quantities greater than 60 grams per day
- taking adequate exercise
- control of stress
- mental relaxation and meditation
- avoidance of tobacco as it is an added risk factor
- avoidance of drugs that raise blood pressure.

It is gratifying to note that these simple measures work in many cases. Drugs should be taken only when prescribed by the doctor. These consist of diuretics which reduce the amount of fluid in the system, beta-blockers, calcium blockers and vasodilators. Mild high blood pressure can be controlled by using simple methods alone. However, if drugs have been prescribed these must be taken regularly under medical supervision. Frequent blood pressure checks are mandatory and can be done by making use of home measurement kits, provided false readings are avoided due to incorrectly calibrated pressure gauge and faulty instruments.

As a preventive measure blood pressure should be checked at least once a year but those who are over-weight, diabetic or have a family history of hypertension should have themselves checked more frequently, once in a month or two weeks.

There are a large number of drugs available for control of high blood pressure. The outlook for the patient with high blood pressure today is a very good one, unlike in the past. What is required is the patient's adherence to the programme as chalked out by the doctor.

Rheumatic Heart Disease

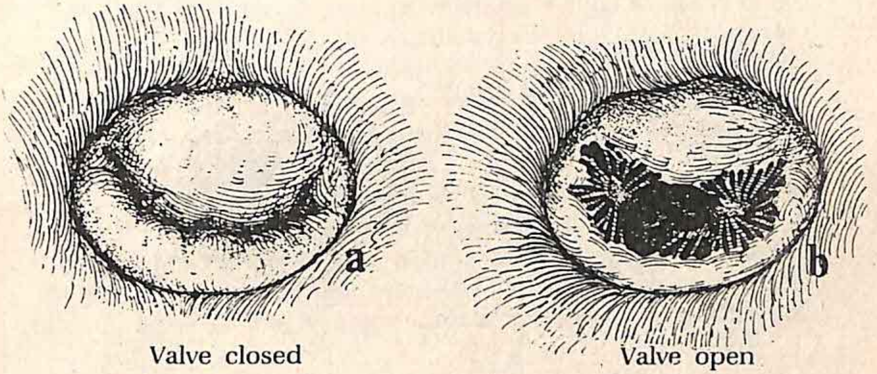
This is a sequel to an infection of the throat by an organism called the B-hemolytic streptococcus. The infection itself may or may not go unnoticed. If of a severe type with typical features, i.e. high fever, redness of the throat, difficulty in swallowing and enlargement of the neck lymph nodes, it may bring the patient to the doctor. After a quiescent period the heart is affected not directly by the organism but by a mechanism not well understood. This is manifested usually 2 or 3 weeks after the throat infection with fever, joint pains and swellings which flit from joint to joint, with carditis, i.e. involvement of the heart which is detected by a fast pulse, pain in the chest and heart murmurs, by nodules in the skin (subcutaneous nodules) and by a special type of skin eruption (erythema marginatum). If promptly treated, this condition called acute rheumatic fever may disappear completely. If untreated the patient will get repeated attacks of the same symptoms preceded by throat infection from time to time. While one attack may not do much damage, repeated attacks do considerable damage. Untreated cases progress to severe valvular heart disease as the process involves all the parts of the heart, namely the valves, myocardium and pericardium. Deformities of the heart valves (mitral stenosis) and mitral regurgitation occur as also aortic regurgitation. If severe, these conditions need surgery in later life often involving replacement of the valves by artificial valves (Fig. 14 & 15).

TREATMENT OF STREPTOCOCCAL THROAT INFECTION

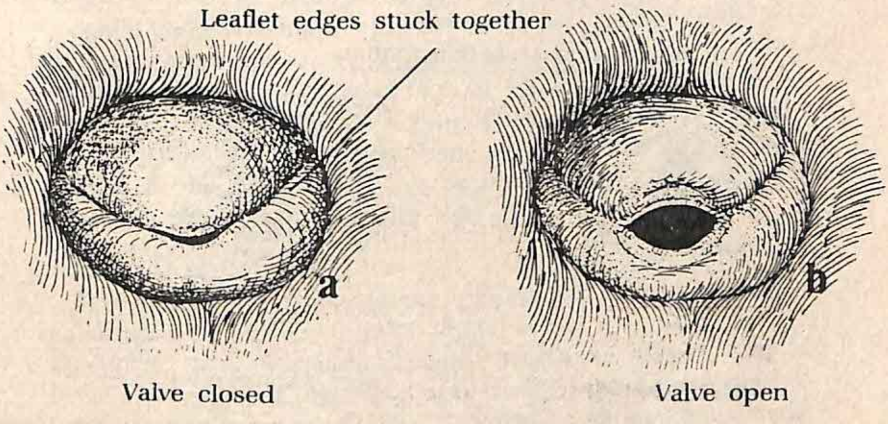
The treatment is very simple with one injection of benzathine penicillin of 1.2 ml. units in adults and 600,000 units in children below 6 years. Other antibiotics such as erythromycin, ampicillin and lincomycin can also be used but, these are more expensive. Drugs which must not be used for acute streptococcal infection are Sulfa drugs, tetracyclines and chloromphonicol. In patients who have had one attack of rheumatic fever, repeated injections of pencillin once in 3 or 4 weeks is mandatory to prevent recurrences of rheumatic fever. This should be carried out for at least 5 years after the initial attack or longer in countries where the disease is extremely common, say even up to 40 to 45 years.

TREATMENT OF RHEUMATIC FEVER

This involves bed rest and the administration of steroids with or without aspirin. If the initial treatment is prompt and adequate, heart damage is minimal and there need be no residual heart disease. Prophylaxis with penicillin is mandatory after an acute attack of rheumatic fever.

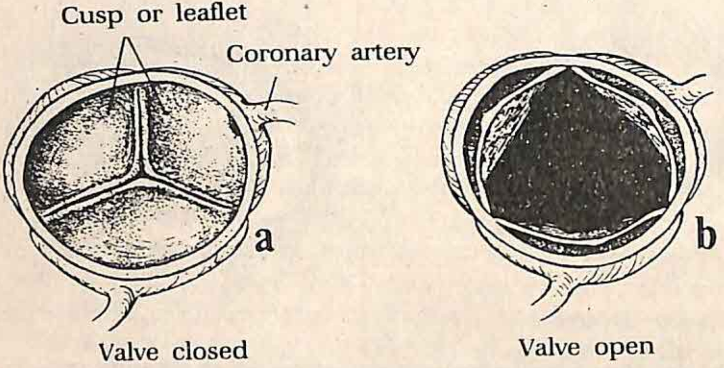


The view of the normal mitral valve as seen from the left atrium. In (a) the mitral valve is closed, preventing blood from escaping from the left ventricle, and (b) is the open position, allowing blood to flow forwards from the lungs and left atrium.



The same view of the mitral valve. This valve is stenotic as a result of rheumatic fever. The edges of the two cusps are fused together: (a) is the closed and (b) is the open position.

Fig. 14. Normal and abnormal mitral valve



The surgeon's view of normal aortic valve. In (a) the valve is closed to prevent blood from flowing back, and in (b) the valve is open to allow blood to escape from the ventricle.

The same view of the aortic valve (from above). The three cusps of the valve have fused together leaving a narrow central opening. Again, (a) is the closed position and (b) is the open position.

Fig. 15 Normal and Abnormal Aortic Valve

SURGICAL TREATMENT

Surgical treatment for severe deformities such as of the mitral valve, of the aortic valve, etc. is expensive as an artifical valve costs about Rs. 10,000 and the cost of the operation is also high. Compared to this, the cost of pencillin injection given once in 3 or 4 weeks works out to about Rs. 40 a year. The rationale for prevention is therefore obvious.

For mild mitral stenosis, a closed heart procedure, such as mitral valvotomy is sufficient to remove the obstruction. For more severe cases a replacement of the valve using open heart surgery is required. In the cases of the aortic valve, the repair is always by open heart surgery and replacement by an artificial valve.

PREVENTION

Many developing countries the world over are evolving programmes for the prevention of rheumatic heart disease as it is an eminently preventable condition if well organised.

PRIMARY PREVENTION

Primary prevention means preventing the initial attack of rheumatic fever by prompt recognition and treatment of streptococcal infection. This is possible with one of the antibiotics already mentioned, after a throat culture is taken and the organism identified. Because of poor laboratory facilities in the developing countries, such a procedure is not always possible and patients go without treatment resulting in rheumatic fever. Even if a throat culture is not possible, many people give an injection of penicillin, on the now or never principle.

SECONDARY PREVENTION

Secondary prevention is the prevention of recurrences of rheumatic fever after an initial attack as the first attack seldom produces massive heart damage. Recurrent attacks can be prevented by giving injections of penicillin once in 3 or 4 weeks for a period of at least 5 years after the initial attack or longer.

This is the most common form of prevention used because of difficulty in preventing first attacks. Children between 5 and 9 years of age should be screened in schools and other places and secondary preventive programmes started as soon as possible and continued for as long as 30 to 45 years. It has been

Table 3

Secondary Prophylaxis of Rheumatic Fever

Medication	*Dosage*
Benzathine Penicillin	1.2 million units I.M. every 3-4 weeks
Penicillin V (oral)	100-125 mg. twice a day
Penicillin G (oral)	200,000 I.U. twice a day
Erythromycin (oral)	250 mg. one daily
Sulphonamide (oral)	.5 to 1 gm. daily

conclusively shown that this procedure results in a low incidence of severe valvular heart disease. The importance of treating sore throats is obvious especially in children between 5 and 15 years of age. Wherever possible, a throat culture should be taken and if a streptococcal throat is diagnosed injection of penicillin given preferably within 3 days of the infection. Where it is not possible to have a throat culture, an injection of penicillin is nevertheless advisable. Allergy to penicillin is uncommon in children and need not be feared as happens in many parts of India where this drug is withheld unnecessarily from children who need it most.

Congenital Heart Disease

The term used now-a-days is congential heart defect rather than congenital heart disease as this is not a disease in the true sense of the word. It occurs in 9 per thousand live births and in 3 per 1000 children in the school-going age of 5 to 15 years.

CAUSES

The causes are not very well known. Sometimes, congenital heart defects occur in families and may be due to genetic defects in the chromosomes. Some are due to German measles before the 8th week of pregnancy. Thalidomide, a drug used for sedation, when given to pregnant mother causes a spate of malformations in babies. There are other causes not yet well defined.

SYMPTOMS

Many congenital malformations are asymptomatic and compatible with a normal life and may not be recognised except during an examination at school or for a job in later life. Some, however, are very symptomatic even from birth and may cause considerable incapacity to a child. One category of this is called "blue baby" in which due to an admixture of oxygenated and non-oxygenated blood, the baby is blue at birth or soon after birth, has shortness of breath, has difficulty in suckling and becomes deeply blue after crying. Some children become so breathless that they have to stop running or playing and have to sit down. One variety of blue baby called the "Tetralogy of Fallot" has very striking symptoms and clinical signs. It was one of the earliest conditions for which surgery was made possible in the winter of 1944.

What must be stressed is that many types of congenital birth defects are compatible with a normal life. Parents should not unnecessarily become worried because the diagnosis of a congenital heart defect has been made. Proper advice should be sought from a competent pediatric cardiologist and treatment, medical or surgical, given.

In India there are several centres today where such treatment can be obtained.

DIAGNOSIS

The diagnosis of these conditions is made by the usual diagnostic tools already outlined including cardiac catheterisation and angiography. Echocardiography is becoming increasingly useful as a method of diagnosing congenital heart defects even without cardiac catheterisation.

TREATMENT

The infant or child, if not severely incapacitated, should be treated as a normal child as much as possible. A normal diet, a normal inoculation schedule and normal schooling should be adhered to. A special precaution needed is prophylaxis against infections of the heart to which such children are prone, by giving a cover of penicillin for all minor operations including dental extraction and dental filling. This should continue even after cardiac surgery.

Surgical treatment is now available for a large number of congenital defects. Some operations are relatively simple while others are more complex. Operations should be carried out as early as possible so that the child can grow into a normal adult. Some of the conditions for which surgery is now available are:-

—atrial septal defect
—ventricular septal defect
—patent ductus arteriosus, coarctation of the aorta, Tetralogy of Fallot, pulmonic stenosis
—tricuspid atresia, and
—transposition of the great vessels.

The outlook, therefore, for babies with congenital defects is far brighter today than it was some 40 years ago.

PREVENTION

German measles before the 8th week of pregnancy carries a risk of 10 to 40% of a cardiac malformation. Many mothers opt for termination of pregnancy under these conditions. Down's Syndrome can be diagnosed by amoniocentesis (puncture of the membranes) and termination of pregnancy can be had under these conditions. Knowledge is not sufficient at the present time to prevent all types of malformations.

CHAPTER—IV

GUIDELINES FOR MAINTENANCE OF HEART HEALTH

The following paragraphs refer to recommendations which can be made from present knowledge of the causation of heart disease, especially heart attacks and hypertension which are the biggest killers in all affluent countries and also in the well-to-do, in developing countries.

A prudent diet beginning preferably in childhood, abstinence from smoking and moderation in drinking alcohol, regular exercise and the maintenance of physical fitness throughout life, a regular check-up particularly in high risk groups with a family history of diabetes, heart attacks, strokes and sudden death particularly below the age of 50, are now believed essential to prevent heart attacks and maintain a healthy life generally. The paragraphs that follow deal with some of these aspects with special reference to conditions prevalent in India.

DIET

The diet should be well balanced with a variety of food eaten each day. Roughly 4 or more servings of the bread and cereal group and the vegetable and fruit group, 2 or more servings of the milk group, 1 or more servings from meat, fish, poultry, eggs, cheese, nuts and dried peas, beans group and normal amounts from the butter/ghee/margarine group are essential for good health.

Most of the recognised risk factors for coronary heart disease are influenced by diet, i.e. one high in calories, saturated fat, cholesterol, salt and refined sugar.

Today's thinking points to the desirability of eating sparingly of fats, particularly saturated fats. Fats should not provide more than 20 to 30% of total calories. Fats include both solid fats and liquid oils. Saturated fats are usually of animal origin such as in meat and meat products, dairy products, such as butter, cream, cheese and milk, coconut and palm oils, and hydrogenated vegetable oils (like vanaspati). Mono-unsaturated fats are found in olive and peanut oils and do not raise the serum cholesterol level. Poly-unsaturated oils lower serum cholesterol level. These are usually oils liquid at room temperature such as safflower (Kardy) sunflower, corn and soyabean oils. The P.S. ratio refers to the proportion of poly-unsaturated fat(P) to saturated fat(S). The higher the poly-unsaturated content in the P.S. ratio of an oil or fat, the better the cholesterol lowering effect. Excessive saturated fats lead to rise in serum cholesterol resulting in fatty deposits in the walls of the blood vessels which cause heart attacks and strokes. Hydrogenated vegetable fats, such as vanaspati also raise the serum cholesterol. A wise mixture of saturated and unsaturated oils is advised. A P.S. ratio of at least 3:1 is desirable (Table 4).

Table 4

Percentage of Saturated and Unsaturated Fat in Commonly Used Cooking Media

FAT/OIL	*PERCENTAGE*			*P/S*
	Poly	*Sat*	*Mono*	*Ratio*
Safflower	72	8	15	9
Corn Oil	53	10	28	5.3
Soyabean Oil	53	15	20	3.5
Sesame Seed Oil	42	16	42	2.6
Peanut Oil	29	18	47	1.6
Olive Oil	7	14	72	0.6
Palm Oil	9	48	43	0.2
Coconut Oil	1	80	5	0.02
Butter	3	45	27	0.05
Margarine—Table	14	35	22	0.4
—Poly-unsaturated	41	16	26	2.5
Peanut Butter	26	18	53	1.5
Beef Fat	2	48	44	0.04
Chicken Fat	20	32	48	0.6
Ghee	33.2	64.2	—	0.5

The following should be used sparingly:-

— organ meats (kidney, liver, brain), ham, sausages, rich cuts of beef, whole milk, processed cheese.

The following can be eaten freely:-
—lean meat, chicken, fish, skimmed milk and cottage cheese.

Refined sugar, apart from producing dental caries, is believed to be responsible for atherosclerosis.

Salt in excess is believed to cause high blood pressure, one of the main risk factors in heart attacks and stroke. The minimum daily recommendation for salt is about 5 gms.—one teaspoon per person. In India, we consume about 10 gms. per person per day.

A vegetarian diet, if adhered to, is ideal, as vegetarians have fewer problems with blood pressure, blood lipids and obesity. Vegetarian diets even if eggs and dairy products are eaten are lower in cholesterol. In India the use of excessive amount of ghee, butter and vanaspati (hydrogenated fats) nullifies the effects of a vegetarian diet.

Fast foods which are becoming increasingly common in India as elsewhere in the world, tend to be high in calories, fat (especially saturated fat), salt and are low in fibre. Examples are Mac Donalds' hamburgers, pizzas, Kentucky fried chicken, French fries, (fried potato fingers), fish and chips and soft drinks. Eating fast foods, regularly several times a week, is conducive to obesity, high blood pressure and heart disease.

ALCOHOL

Alcohol in quantities over 60 grams per day may produce hypertension and is also injurious to the heart in other ways. Amounts up to 60 grams may be taken daily in any form (wine or spirits), if desired. Apart from high blood pressure it may produce elevated blood fats (triglycerides), obesity and a serious condition called cardiomyopathy. The guidelines for pure alcohol intake suggested are the following:

Low risk, less than 60 grams per day in men, 40 grams in women; high risk 60 to 120 grams in men, 40 to 80 grams in women; definite health damage, over 120 grams in men and over 80 grams in women. Alcohol intake even as low as 30 to 40 grams (alcohol blood level of 0.03%) have also been shown to interfere with driving (Table 5).

Table 5

Alcohol Content of Some Alcoholic Beverages

1 gram of alcohol (about 1.16 ml.)=7.1 cal.

		Usual portion in ml.	*Approx. alcohol by vol.*	*Approx. cal. value*
Whisky	Indian	50	43	153
	Foreign	50	50	178
Gin	Indian	50	43	164
	Foreign	50	80	295
Sherry dry		30	18	43
Sherry sweet		30	18	45
Beer brown		250	3	100
Beer strong		250	7	195

OTHER BEVERAGES

Tea and coffee in moderation do not produce any harm. However, excess caffeine especially in people with heart disease may cause problems and under such conditions less than 3 to 4 cups of coffee or 5 to 6 cups of tea are recommended. Garlic and onions may be useful in preventing high serum cholesterol and formation of blood clots. They can be eaten as vegetables in daily meals and although not completely proved, are believed to be beneficial.

VITAMINS

There is no clear evidence that Vitamin E prevents heart disease. The same holds good for Vitamin C.

MINERALS

Minerals such as magnesium, copper and zinc are receiving increasing attention from researchers for their effect on heart disease.

CONTROL OF BODY WEIGHT

Obesity is defined as being above 20% of your ideal body weight as judged from tables provided (see Appendix-1). Angina (heart pain) is 2-3 times more common in obese persons and sudden deaths 4 times more common. Body weight can be controlled by a prudent diet and exercise. Both are important in maintaining ideal body weight.

Weight control is a very important aspect of heart disease prevention as it prevents high blood pressure, elevated blood fat levels and diabetes. It is known that obesity between the ages of 20 and 40 has a greater effect on the development of heart disease rather than over-weight after the age of 40. This emphasizes the importance of controlling body weight from an early age. Ideal height, weight tables are appended at the end of this booklet. and one should not be more than 10% above the ideal weight.

It is much better to be a "weight-watcher" and for long-term weight control, a change in the pattern of eating is required.

For losing weight, calories should be counted, not carbohydrates; crash diets should be avoided as they do not change one's eating habits and one will put on weight the minute the diet is stopped.

Examples of such diets are:–

Scarsdale Diet;
No Carbohydrate Diet;
Mayo Clinic Diet;
Milk & Banana Diet;
Fluids only Diet;
Egg Diet;
Grapefruit Diet;
and Zen Macrobiotic Diet

To lose weight, the aim should be to lose 1/2-1 kg. per week and come down to the ideal weight over several months. A moderate reduction to 1200-1500 calories per day (a lower calorie diet may be required in some cases under medical supervision) consisting of 3-well balanced meals is advised. Eating between meals and use of aerated soft drinks should be avoided.

SMOKING

The ill-effects of smoking have been realised long after it became a habit and a fashionable one at that. Habitual cigarette smoking causes lung cancer, as well as heart attacks, strokes, peripheral blood vessel disease besides a host of other ailments, e.g. peptic ulcer, bronchitis and emphysema, dental diseases, premature delivery and still-births (the last two in pregnant women who smoke). Cigarette smoking combines the ill-effects of nicotine, carbon monoxide tars and other toxins. Nicotine causes the heart to beat faster and harder, may upset the normal rhythm, increases blood pressure, may promote thickening of the arteries and increased clotting in blood vessels.

Carbon monoxide reduces the capacity of the blood to absorb oxygen because red blood cells have a greater affinity for carbon monoxide. Tars and other irritants coat the smoker's lungs and in time reduce the elasticity of the air sacs. This results in smaller amounts of air being breathed and less oxygen going to the blood stream. Women who use birth control pills and also smoke are more prone than others to heart and circulatory diseases. Cigarette smoking is also harmful to non-smokers especially in confined places. Side stream smoke is more harmful than main stream smoke. This has led to the new legislation in many countries to ban smoking altogether in cinemas, offices, buses, aeroplanes and other public places.

The risk of dying suddenly from a heart attack is 2-3 times greater in smokers than non-smokers. People who stop smoking can expect a reversal in the risk of a fatal heart attack. Within a year of stopping, the risk is reduced to almost that of someone who never smoked. A non-smoker aged 32 years can expect to live about 7 years longer than a smoker of the same age.

Beedi smoking, widely prevalent in India, is more harmful because of the higher tobacco content in beedies. Pipe and cigar smoking may be less harmful as the smoke is usually not inhaled, because it is strong. Filter cigarettes contain a lower tar and nicotine content but are not absolutely safe. They may be used during the course of a programme for giving up smoking.

W.H.O., which has now launched a big programme against smoking, believes that in 20 years smoking should be a private activity by addicted persons and says that the tobacco industries' irresponsible behaviour and massive advertising campaigns are causes of a substantial number of unnecessary deaths. It has recommended to all governments that there should be a total prohibition of all forms of tobacco promotion. The only safe level of tobacco smoking is zero. Giving up smoking is not easy. The person has to be strongly motivated and many methods have been suggested for achieving this goal. Sudden or gradual stoppage, the support of friends, switching to low tar or filter cigarettes, use of a holder, pipe or cigar smoking, not inhaling, and taking smaller puffs are all part of the strategy for quitting smoking.

MAINTENANCE OF PHYSICAL FITNESS

PHYSICAL FITNESS

Defined simply, fitness is having energy to perform daily tasks efficiently and with enough reserve energy to enjoy leisure activities. It is not merely a measure of muscle development or strength but also the ability of the heart and lungs to efficiently distribute blood to working muscles and tissues. Fitness is measured by a person's endurance and the speed of recovery to the normal resting state after exertion. Fitness varies from individual to individual and is largely determined by one's inherited constitution. The most important factors for fitness are, regular physical exercise, age, nutrition and overall health.

Unaccustomed and strenuous exercise may be risky but the damage is usually to muscles, ligaments and joints rather than to the heart. However, in those not used to exercise, a medical check-up including an Exercise ECG over the age of 35 to 40 years is recommended. In those with health problems, a medical check-up is always advised.

TYPES OF EXERCISE

Aerobic Exercise

This benefits the heart and general endurance most. Brisk walking, running, cycling, rowing, swimming, volley-ball, squash and tennis fall in this category.

Regular aerobic exercise make the heart pump out more blood with each heart beat and train muscles especially of the legs and thighs to extract more oxygen from the blood. With regular exercise, the heart rate is reduced both at rest and during exercise. It also reduces blood pressure.

Isometric Exercise

These develop muscle bulk through exertion against resistance such as pushing against a wall. It is unsuitable for people with high blood pressure and has little value in heart-lung fitness.

Isotonic Exercise

In this category are, weight-lifting, push-ups, sit-ups and chest expanders. This is also not suitable for patients with high blood pressure.

Callisthenics

These are usually partly isotonic and partly isometric and build agility, coordination and muscular strength particularly of the arms and torso and are recommended in an exercise programme for fitness.

Passive Exercise

These are of no use in improving physical fitness or in weight control. The only work being done is by the machine or mechanical gadget. The amount of physical effort used is negligible.

Fig. 16.
Types of Exercise

GUIDELINES FOR A FITNESS PROGRAMME

For sports in general, we should "get fit to play not play to get fit." Aerobic exercises are the best. Exercise should be vigorous enough to cause heavy breathing or panting but not gasping, and represents 60 to 70% of the maximum possible effort. On the scale, very light, light, fairly hard, hard and very hard, one should exercise at the level "fairly hard".

About 15 to 20 minutes of uninterrupted exercise at a steady pace, at least, 3 to 5 times a week is necessary for maintaining physical fitness.

YOGA

Practised under the guidance of a good teacher, it is extremely beneficial. The more strenuous types should be avoided by heart patients.

MEDITATION

This is also a useful adjunct to exercise and yoga. However, the technique must be learned from a good teacher and practised regularly.

AVOIDANCE OF STRESS

Stress is the pressure exercised on the human body due to problems encountered in life. If the reaction is one of anxiety, frustration or something unpleasant, it leads to "stress", perhaps, more correctly "distress". A certain amount of stress is part of our daily life. If we cannot cope with it, it is a health hazard, not a defence mechanism, as it should be. Stress causes a "fight or flight response" with an increase in blood pressure, a faster heart rate, higher levels of blood fats and increased clotting tendency of the blood. After the acute stress episode, the body returns to normal.

In modern life, stress occurs as a result of financial problems, personality conflicts, competition at work, noise, deadlines, traffic sounds, threat to self respect, etc. to name a few. Emotions are bottled up, pride is swallowed and we keep our cool. The result is a state of chronic anxiety and inability to relax. The body is tuned to a higher action level than it was designed for.

Signs of stress include sleep disturbances, poor concentration, irritability, uneasiness, loss of appetite, headaches, tense muscles, excessive sweating, indigestion, diarrhoea and fatigue. Specific symptoms relating to the heart have already been described.

MANAGING STRESS

The best way of avoiding stress, according to eminent authorities on the subject, is to select an environment (life partner, friends, boss) in line with one's instinctive preferences. Various other strategies have been suggested to protect one from the unpleasant efforts of stress. Among the important ones are aerobic exercises, progressive muscle relaxation, mental relaxation, utilising one of several methods, e.g. non-cult procedures, yoga, TM, bio-feedback, etc. Setting aside a part of the day for relaxation, and getting to "know oneself" help to mitigate the effects of stress.

While stress may not be a major risk factor in heart attacks, it may be "the last straw that breaks the camel's back" in a person already predisposed.

REGULAR PHYSICAL CHECK-UP

This is believed by many to be most useful in early disease detection in detecting risk factors for coronary heart disease, and for timely institution of control measures. Many diseases such as diabetes, high blood pressure and cancer are completely asymptomatic for a long time.

The Armed Forces have regular annual health checks to ensure that a high standard of fitness is maintained. Many industrial organisations have a similar system for their top executives.

It is particularly useful for high risk groups in whom there is a family history of diabetes, heart attacks and high blood pressure.

WHEN SHOULD IT BE DONE?

Ideally it should be undertaken at school after the usual childhood years. At this stage not only should general aspects such as nutrition, body weight, etc. be measured but the inculcation of good habits, e.g. abstinence from smoking, indulgence in regular exercise and sports and avoidance of obesity be stressed. Many congenital malformations of skeletal growth, of the heart and of other organs can be detected at this stage.

It is also desirable to have a second general check-up at the time of taking up employment after leaving school between the ages of 20 to 25. This is as much in the interest of the employer as of the employee. A baseline can be obtained for body weight, B.P. levels, biochemical tests and ECG to name the more important ones.

Following this, a regular check-up is advised after age 35, annually or biennially. This will enable the monitoring of body weight, B.P. levels, hypercholesterolemia and diabetes. Smoking and drinking habits and exercise can be regulated.

Studies in India indicate that smoking (of beedies and cigarettes), high blood pressure and diabetes are the 3-important risk factors for heart attacks. Special attention needs to be paid to these three. Control of body weight is a method of preventing Maturity Onset Diabetes in middle age.

APPENDIX-I

Ideal Weights for Men and Women

(According to Height and Frame. Ages 25 and over)

Height (in Shoes)	*Weight in Kilograms*		*(In-Indoor Clothing)*
	Small Frame	*Medium Frame*	*Large Frame*
		MEN	
157 cm.	50.7-54.3	53.4.58.4	57.0-63.8
160 cm.	52.0-55.7	54.8-60.2	58.4-65.2
163 cm.	53.4-57.0	56.1-61.6	59.7-67.0
165 cm.	54.8-58.4	57.5-64.9	61.1-68.8
168 cm.	56.1-60.2	58.8-64.7	62.5-70.6
170 cm.	57.9-62.0	60.7-66.5	64.3-72.9
173 cm.	59.7-63.8	62.5-68.8	66.5-75.1
175 cm.	61.6-65.6	64.3-70.6	68.4-77.0
178 cm.	63.4-67.9	66.1-72.4	70.2-78.8
180 cm.	65.2-69.7	67.9-74.7	72.0-81.0
183 cm.	67.0-71.5	69.7-77.0	74.2-83.3
185 cm.	68.8-73.3	71.5-79.2	76.1-85.6
188 cm.	70.6-75.6	73.3-81.5	78.3-87.8
190 cm.	72.4-77.4	75.6-83.8	80.6-90.1
193 cm.	74.2-79.2	77.9-86.0	82.4-92.4
			WOMEN
147 cm.	41.6-44.3	43.4-48.4	47.1-53.9
150 cm.	42.5-45.7	44.3-49.8	48.0-55.2
152 cm.	43.4-47.1	45.7-51.1	49.3-56.6
155 cm.	44.8-48.4	47.1-52.5	50.7-57.9
157 cm.	46.2-49.8	48.4-53.9	52.0-59.3
160 cm.	47.5-51.1	49.8-55.2	53.4-60.7
163 cm.	48.9-52.5	51.1-57.0	54.8-62.5
165 cm.	50.2-53.9	52.5-58.8	56.6-64.3
168 cm.	51.6-55.7	54.3-61.1	58.4-66.1
170 cm.	53.4-57.5	56.1-62.9	60.2-67.9
173 cm.	55.2-59.3	57.9-64.7	62.0-69.7
175 cm.	57.0-61.1	59.7-66.5	63.8-71.5
178 cm.	58.8-63.4	61.6-68.4	65.6-73.8
180 cm.	60.7-65.2	63.4-70.2	67.4-76.1
183 cm.	62.5-67.0	65.2-72.0	69.3-78.3

Ideal Weights for Men

Ages 25 and over

Weight in Pounds			*(as ordinary dressed)*	
Height (with shoes)		*Small Frame*	*Medium Frame*	*Large Frame*
Feet	Inches			
5	2	116-125	124-133	131-142
5	3	119-128	127-136	133-144
5	4	122-132	130-140	137-149
5	5	126-136	134-144	141-153
5	6	129-139	137-147	145-157
5	7	133-143	141-151	149-162
5	8	136-147	145-156	153-166
5	9	140-151	149-160	157-170
5	10	144-155	153-164	161-175
5	11	148-159	157-168	165-180
6	0	152-164	161-173	169-185
6	1	157-169	166-178	174-190
6	2	163-175	171-184	179-196
6	3	168-180	176-189	184-202

Ideal Weights for Women

Ages 25 and over

Weight in Pounds			*(as ordinary dressed)*	
Height (with shoes)		*Small Frame*	*Medium Frame*	*Large Frame*
Feet	Inches			
4	11	104-111	110-118	117-127
5	0	105-113	112-120	119-129
5	1	107-115	114-122	121-131
5	2	110-118	117-125	124-135
5	3	113-121	120-128	127-138
5	4	116-125	124-132	131-142
5	5	119-128	127-135	133-145
5	6	123-132	130-140	138-150
5	7	126-136	134-144	142-154
5	8	129-139	137-147	145-158
5	9	133-143	141-151	149-162
5	10	136-147	145-155	152-166
5	11	139-150	148-158	155-169
6	0	141-153	151-163	160-174

(from Metropolitan Life Insurance Co.)

1 pound—0.454 kilos, 1 foot—0.305 metre, 1 inch—2.540 centimetres

APPENDIX-II

Normal Laboratory Values

Blood (B), Plasma (P)
Serum (S), Urine (U)

HEMATOLOGY

Bleeding time: Ivy method, 1-7 minutes (60-420 seconds).
Template method, 3-9 minutes (180-540 seconds).

Cellular measurements of red cells: Average diameter = 7.3 μm (5.5-8.8 μm). *Mean corpuscular volume* (MCV): Men, 80-94 fL, women, 81-99 fL (by Coulter counter).

Mean corpuscular hemoglobin (MCH): 27-32 pg. Mean corpuscular hemoglobin concentration (MCHC): 32-36 g/dL red blood cells (32-36%). Colour, saturation, and volume indices: 1(0.9-1.1).

Clot retraction: Begins in 1-3 hours; complete in 6-24 hours. No clotlysis in 24 hours.

Coagulation time (Lee-White): At 37°C, 6-12 minutes; at room temperature, 10-18 minutes.

Fragility of red cells: Begins at 0.45-0.38% Na Cl; complete at 0.36-0.3% Na Cl.

Hematocrit (PCV): Men, 40-52%; Women, 37-47%.

Hemoglobin: (B) Men, 14-18 g/dL (2.09-2.79 mmol/L as Hb tetramer); women, 12-16 g/dL (1.86-2.48 mmol/L). (S) 2-3 mg/dL.

Partial thromboplastin time: Activated, 25-37 seconds.

Platelets: 150,000-400,000/μL ($0.15\text{-}0.4 \times 10^{12}$/L).

Prothrombin: (P) 75-125%. Less than 2 seconds deviation from control.

Red Blood Count (RBC): Men, 4.5-6.2 million/μL ($4.5\text{-}6.2 \times 10^{12}$/L); women, 4-5.5 million/μL ($4\text{-}5.5 \times 10^{12}$/L).

Reticulocytes: 0.2-2% of red cells.

White Blood Count (WBC) and differential:
5,000-10,000/ιL (5-10 × 10^9/L).

Myelocytes	0%
Juvenile neutrophils	0%
Band neutrophils	0-5%
Segmented neutrophils	40-60%
Lymphocytes	20-40%
Eosinophils	1-3%
Basophils	0-1%
Monocytes	4-8%
Lymphocytes: Total	1,500-4,000/μL
B cell	5-25%
T cell	60-88%
Suppressor	10-43%
Helper	32-66%
H:S	>1

BLOOD, PLASMA, OR SERUM CHEMICAL CONSTITUENTS
(Values vary with method used)

Amylase: (S) 80-180 units/dL (Somogyi). Values vary with method used.

Ascorbic acid: (P) 0.4-1.5 mg/dL (23-85 μmol/L).

Base, total serum: (S) 145-160 meq/L (145-160 mmol/L).

Bicarbonate: (S) 24-28 meq/L (24-28 mmol/L).

Bilirubin: (S) Total, 0.2-1.2 mg/dL (3.5-20.5 μmol/L).
Direct, 0.1-0.4 mg/dL (<7μmol/L). Indirect 0.2-0.7 mg/dL (<12μmol/L).

Calcium: (S) 8.5-10.3 mg/dL (2.1-2.6 mmol/L). Values vary with protein concentration.

Calcium, ionized: (S) 4.25-5.25 mg/dL; 2.1-2.6 meq/L (1.05-1.3 mmol/L).

Ceruloplasmin: (S) 25-43 mg/dL (1.7-2.9 μmol/L).

Chloride: (S or P) 96-106 meq/L (96-106 mmol/L).

Cholesterol: (S or P) 150-280 mg/dL (3.9.7.28 mmol/L) (See Lipid fractions.) Values vary with age.

Cholesterol esters: (S) 65-75% of total cholesterol.

CO_2 Content: (S or P) 24-29 meq/L (24-29 mmol/L)

Complement: (S) C3 (βIC), 90-25 mg/dL. C4 (β 1E), 10-60 mg/dL. Total (CH 50), 75-160 mg/dL.

Copper: (S or P) 100-200 ug/dL (16-31 umol/L).

Cortisol: (P) 8.00 AM, 5-25 μg/dL (138-690 mmol/L); 8.00 PM, <10μg/dL (275 mmol/L).

Creatine Kinase (CK): (S) 10-50 IU/L at 30°C. Values vary with method used.

Creatinine: (S or P) 0.7-1.5 mg/dL (62-132 .μmol/L).

Epinephrine: (P) Supine, <0.1 ug/L (<0.55 nmol/L).

Ferritin: (S) Adult women, 20-120 ng/mL; men, 30-300 ng/mL. Child to 15 years, 7-140 ng/mL).

Folic acid: (S) 2-20 ng/mL (4.5-45 nmol/L) (RBC)> 140 ng/mL (>318 nmol/L).

Glucose: (S or P) 65-110 mg/dL (3.6-6.1 mmol/L).

Haptoglogin: (S) 40-170 mg of hemoglobin-binding capacity.

Iron: (S) 50-175 μg/dL (9.31-3 μmol/L).

Iron-binding capacity. (S) Total, 250-410 ug/dL (44.7-73.4 umol/L percent saturation, 20-55%.

Lactate: (B, special handling) Venous, 4-16 mg/dL (0.44-1.8 mmol/L).

Lactate dehydrogenase (LDH): (S) 55-140 IU/L at 30°C, SMA 100-225 IU/L at 37°C, SMAC, 60-200 IU/L at 37°C.

Lipase: (S) 0.2-1.5 units.

Lipid fractions: (S or P) Desirable levels: HDL cholesterol, >40mg/dL; LDL cholesterol, <180 mg/dL; VLDL Cholesterol, <40 mg/dL. (To convert to mmol/L, multiply by 0.026).

Lipids, total: (S) 450-1000 mg/dL (4.5-10 g/L)

Magnesium: (S or P) 1.8-3 mg/dL (0.75—1.25 mmol/L)

Non-protein nitrogen (NPN): (S) 15-35 mg/dL 14-21 mmol/L). Do not use anti-coagulant containing ammonium oxalate.

Osmolality: (S) 275-295 mosm kg water.

Oxygen: Capacity: (B) 16-24 vol%. Values vary with hemoglobin concentration.

Arterial Content: (B) 15-23 vol%. Values vary with hemoglobin concentration.

Arterial % saturation: 94-100% of capacity.

Arterial PO_2 (PaO_2): 80-100 mm Hg (10.67-13.33 kPa) (sea level). Values vary with age.

PaCO2: (B, arterial) 35-45 mm Hg (4, 7-6 kPa).

pH (reaction): (B, arterial) 7.35-7.45 (H+44.7-45.5 nmol/L).

Phosphatase, acid: (S) 1-5 units (King-Armstrong), 0.1-0.63 units (Bessey-Lowry).

Phosphorus, inorganic: (S, fasting) 3-4.5 mg/dL (1-1.5 mmol/L).

Potassium: (S or P) 3.5-5 meq/L (3.5-5 mmol/L).

Protein:

Total: (S) 6-8 g/dL (60-80 g/L).
Albumin: (S) 3.5-5.5 g/dL (35-55 g/L).
Globulin: (S) 2-3.6 g/dL (20-36 g/L).
Fibrinogen): (P) 0.2-0.6 g/dL (2-6 g/L).

Separation by electrophoresis:
Protein fractions as determined by electrophoresis.

	Percentage of Total Protein
Albumin	52-68
a1 globulin	2.4-4.4
a2 globulin	6.1-10.1
β globulin	8.5-14.5
γ globulin	10-21

Pyruvate: (B) 0.6-1 mg/dL (70-114 ιmol/L).

Serotonin: (B) 0.05-0.2 ιg/mL.

Sodium: (S or P) 136-145 meq/L (136-145 mmol/L).

Specific gravity: (B) 1.056 (varies with hemoglobin and protein concentrations). (S) 1.0254-1.0288 (varies with protein concentration).

Transferrin: (S) 200-400 mg/dL (23-45 µmol/L).

Triglycerides: (S) <165 mg/dL (1.9mmol/L). (See Lipid fractions).

Urea nitrogen: (S or P) 8-25 mg/dL 2.9-8.9 mmol/L). Do not use anti-coagulant containing ammonium oxalate.

Uric acid: (S or P) Men, 3-9 mg/dL (0.18-0.54 mmol/L), women, 2.5-7.5 mg/dL (0.15-0.45 mmol/L).

Vitamin A: (S) 15-60 µg/dL (0.53-2.1 µmol/L).

Vitamin B12: (S) >200 pg/mL (>148 pmol/L).

Vitamin D: (S) Cholecalciferol (D3): 25-Hydroxycholecalciferol, 10-80 ng/mL (26-208 nmol/L); 1,25-dihydroxycholecalciferol, 21-45 pg/mL (50-108 pmol/L); 24, 25-dihydroxycholecalciferol, 1-5 ng/mL (2.4-12 nmol/L).

Volume, blood (Evans blue dye method): Adults, 2990-6980 mL. Women, 46.3-85.5 mL/kg; men, 66.2-97.7 mL/kg.

Zinc: (S) 50-150 µg/dL (7.65-22.95 µmol/L).

HORMONES, SERUM OR PLASMA

Adrenal: *Aldosterone*: (P) Supine, normal salt intake, 2-9 ng/dL (56-250 pmol/L); increased when upright *Cortisol*: (S) 8.0 AM, 5-20 µg/dL (0.14-0.55 µmol/L); 8.00PM <10µg/dL.

Deoxycortisol: (S) Baseline, 50-250 ng/dL (1.44-7.2 nmol/L); after metyrapone >7 µg/dL (>0.2 µmol/L).

Dopamine: (P)< 135 pg/mL.

Epinephrine: (P) < 0.1 µg/L (<0.55 nmol/L).

Norepinephrine: (P)<0.5 µg/L (<3 nmol/L).
See also Miscellaneous Normal Values.

Thyroid: Thyroxine, free (FT4): (S) 0.8-2.4 ng/dL (0.01-0.03 nmol/L).

Thyroxine, total (TT4): (S) 5-12 μg/dL (65-156 nmol/L) (by RIA).

Thyroxine-binding globulin (TBG): (S) 2-4.8 mg/dL (20-48 mg/L).

Triiodothyronine (T3): (S) 80-220 ng/dL (1.2-3.3 nmol/L).

Reverse triiodothyronine (rT3): (S) 30-80 ng/dL (0.45-1.2 nmol/L).

Triiodothyronine uptake (RT3U): (S) 25-36% as TBG assessment (RT3U ratio), 0.85-1.15.

Calcitonin: (S) <400 pg/mL (<117 pmol/L).

Islets:

Insulin: (S) 4-25 μU/mL (29-181 pmol/L).
C-peptide: (S) 0.9-4.2 ng/mL.
Glucagon: (S, fasting) 20-100 pg/mL.

Stomach:

Gastrin: (S, special handling) upto 100 pg/mL (47 pmol/L). Elevated, > 200 pg/mL.
Pepsinogen I: (S) 25-100 ng/mL.

Kidney:

Renin activity: (P, special handling) Normal sodium intake
Supine, 1-3ng/mL/h; standing, 3-6 ng/mL/h. Sodium depletd. Supine, 2-6 ng/mL/h; standing, 3-20 ng/mL/h.

Gonad:

Testosterone, free: (S) Men, 10-30 ng/dL; women, 0.3-2 ng/dL. (1 ng/dL=0.035 nmol/L).

Testosterone, total: (S) Prepubertal, <100 ng/dL; adult men, 300-1000 ng/dL; adult women, 20-80 ng/dL; luteal phase, upto 120 ng/dL.

Estradiol (E2): (S, special handling) Men, 12-34 pg/mL, women, menstrual cycle 1-10 days, 24-68 pg/mL; 11-20 days, 50-186 pg/mL; 21-30 days, 73-149 pg/mL (by RIA) (1 pg/mL=3.6 pmol/L).

Progesterone: (S) Follicular phase, 20-150 ng/dL; luteal phase, 300-2400 ng/dL; pregnancy, > 2400 ng/dL; men, <100 ng/dL (by RIA). (1 ng/dL=30pmol/L).

Placenta:

Estriol (E3): (S) Men and non-pregnant women, <0.2 μg/dL (< 7 nmol/L) (by RIA).

Chorionic gonadotropin: (S) Beta subunit: Men, < 9 mIU/mL; pregnant women after implantation, > 10 mIU/mL.

RENAL FUNCTION TESTS

p-Aminohippurate (PAH) clearance (RPF): Men, 560-830 mL/min; women, 490-700 mL/min.

Creatinine clearance, endogenous (GFR): Approximates inulin clearance (see below).

Filtration fraction (FF): Men, 17-21%, women, 17-23% (FF=GFR/RPF).

Inulin Clearance (GFR): Men, 110-150 mL/min; women 105-132 mL/min (corrected to 1.73 m^2 surface area).

Maximal glucose reabsorptive capacity (Tmg): Men, 300-450 mg/min; women, 250-350 mg/min.

Maximal PAH excretory capacity (TmPAH): 80-90 mg/min.

Osmolality: On normal diet and fluid intake: Range 500-85Omosm/kg water. Achievable range, normal kidney, Dilution 40-80 mosm; concentration (dehydration) upto 1400 mosm/kg water (at least 3-4 times plasma osmolality).

Specific gravity of Urine: 1.003-1.030.

MISCELLANEOUS NORMAL VALUES

Adrenal hormones and metabolites:
Aldosterone (U) 2-26 μg/24h (5.5-72 nmol). Values vary with sodium and potassium intake.

Catecholamines: (U) Total <100 ιg/24h. Epinephrine, < 10 ιg/24h (<55 nmol); norepinephrine, < 100 μg/24h (<591 nmol). Values vary with method used.

Cortisol, free: (U) 20-100 μg/24h (0.55-2.76 μmol).

11, 17-Hydroxycorticoids: (U) Men, 4-12 mg/24 h; women, 4-8 mg/24h. Values vary with method used.

17-Ketosteroids: (U) Under 8 years, 0-2 mg/24 h; adolescents, 2-20 mg/24h. Men, 10-20 mg/24h, women, 5-15 mg/24h. Values vary with method used.

Vanillylmandelic acid (VMA): (U) Upto 7 mg/24h <35 ιmol).

Fecal fat: Less than 30% dry weight.

Lead: (U) < 0.12 mg/24h (<0.57 μmol).

Porphyrins:
Delta-aminolevulinic acid: (U) 1.5-7.5 mg/24h (11.4-57.2 μmol).

Coproporphyrin: (U)< 230 μg/24h (< 345 nmol).

Uroporphyrin: (U) <50 μg/24h (<60 nmol).

Porphobilinogen: (U) < 2mg/24h (<8.8 μmol).

Urobilinogen: (U) 0-2.5 mg/24h (<4.23 μmol).

Urobilinogen, fecal: 40-280 mg/24h (68-474 μmol).

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Dr. S. Padmavati F.R.C.P (Lond.), F.R.C.P.E., F.A.C.C., F.A.M.S., has been engaged in patient care for over 35 years and has to her credit over 300 publications in Indian and foreign journals of repute. Dr. Padmavati was formerly Professor of Medicine at the Lady Hardinge Medical College and subsequently Director, Maulana Azad Medical College and the Irwin and G.B. Pant hospitals. She is now President of the All India Heart Foundation and heads the new National Heart Institute of the Foundation opened in 1981.

A recipient of the Padma Bhushan, the Rajaji Ratna Award, the B.C. Roy National Award and the Kamla Menon Research Award among others, she is also a member of the expert committee on the cardiovascular diseases for WHO and of the ISFC committee for world-wide control of rheumatic heart disease.

The very mention of heart disease strikes terror in the minds of many. This book is intended to put into proper perspective what heart disease means, and explain in simple terms the changes that occur when a heart becomes deranged in structure and function. The symptoms and signs of heart disease and common methods of examination of the heart are discussed. Methods of treatment, medical and surgical, and more important, preventive steps that can today be taken to ward off heart disease are outlined. It is hoped that this book will prove useful in allaying unnecessary fears associated with heart ailments.

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